

# The Ethical and Privacy Implications of Mixed Reality

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Figure 1: Participants in Marshmallow Laser Feast's installation, *We live in an Ocean of Air*, at the Saatchi Gallery in London

## ABSTRACT

The spatial computing affordances of virtual and augmented reality introduce new ethical and privacy dilemmas. This panel will explore the many implications of biometric data (eye tracking, facial tracking, gait detection, emotional sentiment analysis, galvanic skin response, EEG, EMG, and ECG) to contextually-aware computing that can scan and identify your immediate surroundings. There are many unknown ethical thresholds with immersive computing, and this panel will discuss our own moral intuitions on the topic while inviting the audience to share their own questions and insights for how to navigate this landscape.

## CCS CONCEPTS

- **Human-centered computing** → *Mixed / augmented reality*;
- **Social and professional topics** → *Codes of ethics*.

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## KEYWORDS

mixed reality, privacy, augmented reality, virtual reality, ethics

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## 1 INTRODUCTION

Mixed Reality (MR) devices blend virtual and physical elements to create a new concept of reality.

This panel will share takeaways from the VR Privacy Summit at Stanford University in 2018, including some of the best practices for navigating the privacy implications of XR, a framework for mixed reality permissions on the immersive web from Mozilla, and best practice insights for privacy from one of the leading AR cloud startups. We'll also explore how blockchain technologies are forming new emerging W3C standards of decentralized identity and the relationship between self-sovereign identity and spatial computing.

Creating a comprehensive framework for navigating the ethical and privacy implications of mixed reality is a massive undertaking, and this panel discussion is meant to open up the dialogue with the larger spatial computing industry as there are currently more open questions than answers. As these devices become more integrated

in our daily lives, it's imperative that we determine how to define and protect privacy in an immersive world.

Unlike physical environments, virtual environments can be modified quickly and easily with the goal of influencing behavior. Behavioral manipulations can range from increasing saving behavior via age-progressed avatar embodiment [Hershfield et al. 2011] to increasing self-objectification via sexualized avatars [Fox et al. 2013] and reinforcing gender stereotypes [Christy and Fox 2014]. To what extent are these manipulations acceptable? How can we balance consent with potentially influencing positive behaviors?

## 2 BIOMETRIC DATA

Consent for sharing data on the 2D web has traditionally been based upon our behaviors or information that we consciously share, but biometric data introduces new methods for gaining insights into our emotions and subjective experiences that's based upon information that unconsciously radiate from our body.

A wide range of biometrics can be collected by head-mounted displays (HMDs), some of which are non-obvious to users. In addition to eye-tracking data, we can collect information on users' gait, height, as well as emotional and physical reactions.

Biometric information presents particularly difficult problems. Firstly, once exposed, there's no way to retrieve or change it. Even worse, it provides methods for fingerprinting users by their physical attributes, not just their behaviors. For example, Oculus' privacy policy explicitly states that the devices collect "information about your environment, physical movements, and dimensions when you use an XR device." [ocu 2018]

Biometrics also provide insight into involuntary nonverbal reactions, which can be used to rate users' opinions of experiences and determine engagement with advertisements [Bailenson 2018]. These reactions can also be used to diagnose PTSD [Loucks et al. 2019], anxiety disorders [Dechant et al. 2017], and Alzheimer's disease [Howett et al. 2018]. Some companies are already using VR during interviews to determine how applicants will react to various scenarios. Imagine if during an interview, your headset is collecting data that could reveal that you have initial signs of Alzheimer's disease to your potential employer.

Gaze data can also reveal users' sexual preferences [Renaud et al. 2002]. This could be refined by incorporating galvanic skin response, heart rate, and other data sources we expect will be integrated into MR devices in the future.

In short, it may turn out that biometric data may provide a Rosetta Stone to the most personal aspects of our psyche where the boundary predicting behavior and controlling behavior starts to disappear. There may be some amazing insights that could be gained by capturing and analyzing patterns in our biometric data, but there are also many risks associated with how our biometric data could be used against us. Part of the ethical dilemma around biometric data is deciding how much of it should be considered ephemeral and not recorded versus how much we want to allow technology to imperfectly attempt to quantify our emotional sentiment to a variety of input stimuli as part of a permanent record about us.

## 3 CONCLUSIONS AND FUTURE WORK

Coming up with a comprehensive ethical design framework for mixed reality is a big open problem. There are so many new ethical dilemmas with tradeoffs between competing interests without a perfect solution. Our intention with this paper and our panel discussion at the SIGGRAPH 2019 Conference is to continue the conversation exploring some of the major categories of ethical and privacy challenges introduced by XR technologies. If spatial computing really does turn out to be a new paradigm in human-computer interaction, then we will need a new ethical design principles to help guide our experiential design frameworks.

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